

GOSHEN BRIDGE

(Bridge No. 6145)

Spanning the Calfpasture River at Virginia Route 746

Goshen Vicinity

Rockbridge County

Virginia

HAER No. VA-102

HAER
VA
88-GOSH.V,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service

Northeast Region

U.S. Custom House

200 Chestnut Street

Philadelphia, PA 19106

HISTORIC AMERICAN ENGINEERING RECORD
GOSHEN BRIDGE
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LOCATION: Virginia State Route 746 over the Calfpasture River, Goshen vicinity, Rockbridge County, Virginia.
USGS Goshen, VA Quadrangle, Universal Transverse Mercator Coordinates: 17.632220.4204980

DATE OF CONSTRUCTION: 1890

ENGINEER: David C. Humphreys, Engineer of Construction, Rockbridge County, Virginia

BUILDER: Groton Bridge Company, Groton, New York

PRESENT OWNER: Virginia Department of Transportation

SIGNIFICANCE: The Goshen Bridge is a representative example of a pin-connected steel Pratt through truss, typical of late nineteenth century factory-manufactured bridges.

PROJECT INFORMATION: The Goshen Bridge was recorded in 1993-1994 by the Cultural Resource Group of Louis Berger & Associates, Inc., Richmond, Virginia, for the Virginia Department of Transportation (VDOT). The recordation was undertaken pursuant to provisions of a Programmatic Memorandum of Agreement (Draft) among the Federal Highway Administration, VDOT, the Virginia SHPO, and the Advisory Council on Historic Preservation concerning management of historic metal truss bridges in Virginia. Project personnel included Richard M. Casella, Architectural Historian, Alison Helms, Historian, and Bruce Harms, Photographer.

DESCRIPTION

Goshen Bridge (VDOT Bridge No. 6145) is a skewed two-span, pin-connected steel through truss bridge which carries Virginia State Route 746 in a northeast-southwest direction over the Calfpasture River, 0.03 miles east of Route 39, in the town of Goshen, Rockbridge County, Virginia. The river is approximately 180' wide at the bridge, and is spanned by the trusses at a height of about 20' (Figure 1).

The two trusses are of the Pratt type, with parallel chords, posts in compression, and diagonals in tension. All members of the trusses are steel, joined with pinned, riveted, or threaded connections. Both trusses are 24' high and 25' 2" wide. Originally, the bridge carried two travel lanes; however, at some point the floor stringers and decking of the north lane were removed, presumably to limit vehicular loading. The east truss is 138' 9-1/2" long, with eight panels each 17' 3" wide (Figure 2). The west truss is 121' 8-1/2" long, with seven panels each 17' 3" wide (Figure 3). Overall, the bridge is 260' 6" long. The two trusses are identical in construction except for their length and the dimensions of certain structural members. The description of the bridge members that follows will apply to both trusses unless otherwise noted.

Top chords and inclined end posts are riveted box sections, 14" x 9-3/8" overall, built with 14" top plate, 9" x 2-1/4" side channels with flanges turned out, and single bar-lattice. The truss rides on friction-plate bearings and fixed bed-plate bearings, both types measuring 16" x 18" overall. Bottom chords consist of paired die-forged eyebars and vary in size. The bottom chords of the east truss measure 3" x 15/16" at panels one and two, 4" x 1-1/4" at panel three, and 4" x 1-1/2" at panel four. The bottom chords of the west truss measure 2-1/2" x 15/16" at panels one and two, 4" x 1" at panel three, and 4" x 1-1/8" at the center panel.

The riveted box-section bar-lattice posts are of four sizes, all constructed of two channels with flanges turned out and connected with double bar-lattice. Depending on the location of the posts, they are constructed with either 5", 6", 7", or 8" channels.

Main diagonal panel braces consist of paired die-forged eyebars. The adjustable counter braces are round loop-welded eyebars, with upset threads and turnbuckles. The main diagonals of the east truss measure 3" x 1-13/16" in panel two, 3" x 7/8" in panel three, and 2" x 3/4" in panel four. The east truss counters measure 7/8" in panel three and 1-1/4" in panel four. The main diagonals of the west truss measure 3" x 1" in panel two and 2" x 1" in panel three. The west truss counters measure 1" in panel three and 1-1/2" in the center panel where there are two opposing counters. Hip-verticals consist of paired die-forged eyebars measuring 2" x 3/4". Bottom chord pins and top end post pins are 3-3/8"; intermediate top chord pins are 2-3/8".

Portal struts consist of a lattice-bar girder, approximately 30" x 6" overall, with T-section flanges and triple intersecting lattice-bar webbing. Upper lateral struts are lattice-bar I-sections, approximately 12" x 5" overall, consisting of T-section flanges and single lattice-bar webbing.

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Upper lateral bracing consists of 1" threaded rods attached to the strut endplates with skewback brackets. Sway braces are located at each lateral strut and consist of riveted T-sections.

The plate girder floor beams measure 30" x 10-1/4", constructed of 1/4" web-plate and 5" x 3" angle flanges. The girders are stiffened with 3" x 2-1/2" angles spaced 4' on center. The girders are suspended from the bottom chord pins at each post by 1-1/4" diameter U-bolts which pass through holes in the girder flanges. Six 10" x 4" I-beam floor stringers, spaced 25-1/2" apart, rest on the girder to carry the floor of the single remaining traffic lane. Bottom lateral bracing rods are threaded at both ends and connect with skewback brackets riveted to the girders.

The bridge decking consists of 4" x 10" pressure-treated wood planks laid diagonal and attached to the stringers with carriage bolts and deck clips. As mentioned above, one lane of bridge decking has been removed. The roadway is 12' wide and edged with 4" x 5" wood curbing raised 4" off the decking with wood blocks spaced approximately 4' on center. The bridge railings consist of two horizontal rows of 1-1/2" pipe, 10" and 30" off the deck. The railing is attached to the bridge posts on the south side and to 4" x 4" wood posts on the north side.

The trusses rest on straight abutments and a center channel pier, all constructed of quarry-faced coursed ashlar limestone. The abutments are approximately 10' high and the pier is about 20' high.

A rectangular cast iron builder's plaque is mounted on the top of the portal strut at each end of the bridge. The plaque is eclectically decorated with motifs that can be loosely associated with the Classical and Elizabethan architectural styles. Cusped brackets, resembling a crescent moon, brace the lower corners of the plaque and are repeated elsewhere in smaller versions. Three crests in the shape of ball-and-obelisk finials surmount the plaque at its center and corners. Each crest is pierced with a trifoliate clover leaf and stem. Both sides of the plaques are embossed with lettering, the front and back reading, respectively, as follows:

1890
GROTON BRIDGE
& MFG. CO.
BUILDERS
GROTON, N.Y.

1890
GOSHEN LAND & IMP. CO.
COL. R.P. CHEW, PRESIDENT.
J. FRED EFFINGER, VICE PRESIDENT.
C.L. COOKE, SEC'Y AND TREAS.
C.P. EHRMAN, GEN. MANAGER.
D.C. HUMPHREYS, ENGINEER

The end posts of the trusses are capped with stamped metal crests which resemble finials, but are of an unusual and possibly unique shape which lacks any clear associative architectural style.

HISTORICAL INFORMATION

Background

The confluence of the Calfpasture River and Mill Creek is located in a remote area of Rockbridge County known as the Pastures. This area is separated from the rest of the county by the North Mountain Range, breachable most easily at Goshen Pass, where the Maury River cuts through the mountain (Tennery and Scott 1989:31). The scenic character of the pass, located approximately four miles southeast of Goshen, pleased many summer visitors who traveled to the area during the middle and late nineteenth century to relax and convalesce at the local resorts and mineral springs (Allen 1983:7; Hall et al. 1985:7).

The rich farmland in the Calfpasture River Valley near its junction with Mill Creek was settled in the 1740s by agriculturalists of English, Scottish, and German descent, and the first mill in the area was built in 1745. The preferred crop in the area was corn, which continued to be popular well into the nineteenth century. The minerals in the mountains, especially the rich local iron ores, were exploited soon after the first settlements were made (Hall et al. 1985:2). Prior to the Civil War, as many as ten charcoal-powered iron furnaces were established in the region. This area became one of the highest producers of iron in the state, and during the Civil War, manufactured more iron for the Confederacy than any other area of the south (Allen 1983:11; Hall et al. 1985:3).

The railroad first passed through the rich farmland of the Calfpasture River Valley in 1855, when the Virginia Central company extended track from Staunton to Clifton Forge. After it was destroyed in the Civil War, the line was acquired by the Chesapeake and Ohio (C&O) Railway Company and became part of their main route between Washington, D. C., and Cincinnati, Ohio. The C&O Railway Company named Goshen Depot after the prosperous and lovely farm owned by Squire Joseph Bell, Jr. His father, Joseph Bell Sr., had been living in the area since 1817, and was the son of George Washington Bell, who built a brick manor house on the east side of the river in about 1800 (Hall et al. 1985:1, 6; Rockbridge County Deed Book 57:329; Tennery and Scott 1989:32). By 1883, probably around the time the iron railroad bridge over the Calfpasture River was built, the small agricultural and industrial community centered around the depot became known as Goshen Bridge (Carmichael 1883).

Railroad technology brought agricultural prosperity and an industrial-based boom to the entire Shenandoah Valley in the 1880s and 1890s, and prompted a wave of speculation that resulted in the establishment of new towns and industries (Hensley 1979:14). The Victoria Furnace, built about one mile south of Goshen in 1883 by an English company, was one manifestation of this

boom. The furnace and the railroad spur which connected the mines with the furnace and the C&O Railway were built at a cost of over \$1,250,000 (Allen 1983:11-13; Carmichael 1883).

The town of Goshen was chartered in 1884 and was greatly expanded in 1890 by the Goshen Land and Improvement Company, which in the spring of that year purchased the Victoria Furnace, the Cold Sulphur Spring resort, and several farms in the area, including the 240-acre Bell farm (Hall et al. 1985:9; Rockbridge County Deed Book 57:329). Like many development companies operating in the Shenandoah Valley during the 1880s and 1890s, the Goshen Land and Improvement Company was made up of hard-working capitalists with considerable experience in business, law, development, and industry. The company was incorporated on April 26, 1890. During its first year of operation, company officers included the following: Colonel R.P. Chew of Charleston, West Virginia, President and Director; J. Fred Effinger, an attorney from Staunton, Virginia, Vice President and Director; Charles L. Cooke of Staunton, Secretary, Treasurer, and Director; C.P. Ehrman of Staunton, General Manager and Director; Major Holmes Conrad of Winchester, Virginia, Director; and Governor A.B. Flemming of Charleston, West Virginia, Director (*Goshen Blade* 1891; Rockbridge County Charter Book 1:149-150; Rohrer & Diamond 1899:7).

According to the charter, the company was formed for the purposes of buying and selling real estate, laying out town lots and streets, building iron, wood, clay, and wool and cotton manufactories, building water works, gas works, and electric light and power works, building steam railways, building hotels, and mining and transporting iron and other ores (*Goshen Blade* 1891; Rockbridge County Charter Book 1:149-150).

In 1890, the Goshen Land and Improvement Company devised a street plan, including town and industrial lots, covering areas on both the east and west sides of the Calfpasture River. The company established an office in Goshen, where a plat of the town with some nine thousand home sites was displayed. A copy of the same plat was recorded at the Rockbridge County Courthouse on November 14, 1890 (Allen 1983:3; Rockbridge County Plat Book 1:110).

Located in an area rich in iron reserves, and on the C&O railway line within easy hauling distance of the best coalfields of Virginia and West Virginia, the town was ideally situated for rapid industrial growth. The first 30' by 120' town lot in Goshen was sold on October 10, 1890 (Rockbridge County Deed Book 69:4). By mid-June of 1891, the town of Goshen was booming, and five industrial enterprises—Victoria Furnace, Keystone Machine Company, Woodcock Iron Works, a sawmill, and the Goshen Brick Company—were operating. In addition, the Goshen Car Railway Equipment Company, with lumber yards covering fourteen acres, was nearing completion. The electric light building, and the Goshen Rolling Mill, one of the finest plants of its kind in the south, were scheduled to open together on July 4, 1891. The company also expected to open the Palace (Alleghany) Hotel, a grand and luxurious accommodation designed by Stanford White of New York City, before the end of the summer (*Goshen Blade* 1891).

History of Goshen Bridge

Goshen Bridge was built jointly by the Goshen Land and Improvement Company and Rockbridge County during the winter of 1890-1891 and completed in the spring of 1891. The bridge was built to carry highway traffic over the Calfpasture River on the county road between Lexington and Staunton. When the Goshen Land and Improvement Company laid out the town of Goshen in 1890, the preexisting county road was absorbed into the new town plan and named Maury Avenue. According to the plan, the bridge was to link the east and west sides of town, physically separated by the Calfpasture River (Rockbridge County Plat Book 1:110). Maury Avenue has since been renamed State Route 746. The bridge, located south of the junction of Mill Creek and the Calfpasture River, at the east end of the town of Goshen, was the first bridge built at this site.

On March 17, 1888, two years before the Goshen Land Company began speculative development in the area, J.F. Hite and other members of the communities near Goshen Depot petitioned the Rockbridge County Board of Supervisors for construction of three separate bridges in their area, across Calfpasture River, Mill Creek, and Bratton's Run. The Board appointed a committee made up of supervisors H.S. Beard, John H.B. Jones, and H.T. Lindsay to assess the importance and necessity of the proposed bridges and the probable costs of construction (Rockbridge County Supervisors Order Book 2:225).

On June 2, 1888, the committee returned a report to the Board recommending that a bridge be built over the Calfpasture River on the county road near Goshen Depot. On September 3, the county court directed that the Board of Supervisors decide whether the cost of the bridge should be borne by the entire county, or by one or more districts standing to benefit most from the construction (Rockbridge County Court Order Book 1887:229; Rockbridge County Supervisors Order Book 2:231).

At a September 12, 1888, meeting of the Board of Supervisors, the Road Commissioners of Walker's Creek Magisterial District contributed \$250 toward the construction of the bridge and local subscribers donated approximately \$150 to the project. After reviewing the matter, the Board concluded that the proposed bridge was of general importance to the county, and ordered that the remainder of the cost of construction should come from county funds (Rockbridge County Supervisors Order Book 2:252).

On October 1, 1888, the Board of Supervisors notified the court that funding for the bridge construction could not be realized from the county levy for 1888, and the court directed that the petition be continued (Rockbridge County Court Order Book 1887:236). On March 4, 1889, the matter was retired from the docket until the Board of Supervisors should be prepared to take action, and the petitioners were given leave to reinstate the cause when that time came (Rockbridge County Court Order Book 1887:332).

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A little over a year later, on April 11, 1890, the matter was brought again before the county court, and this time it was ordered that a substantial bridge be built across the Calpasture River at Goshen. Four commissioners, L.L. Watson, J.P. Moore, D.C. Humphreys, and Mc.M. Sterrett, were appointed to prepare and adopt plans and specifications for building the bridge, to advertise for bids for the construction of masonry substructure and iron superstructure, and to award the contracts (Rockbridge County Court Order Book 1889-1890:225-226).

On June 7, 1890, the commission reported to the court that it had contracted with George H. Cameron and M.H. Johnson for construction of the abutments, and with the Groton Bridge and Manufacturing Company of Groton, New York, for building the superstructure. The court approved the contracts and appointed David C. Humphreys, a civil engineer from Lexington, Virginia, Engineer and Superintendent in charge of the construction of the bridge. The commissioners were ordered to examine the structure when it was completed, and to report to the court whether the work was done in accordance with the agreements (Rockbridge County Court Order Book 1889-1890:332).

On August 4, 1890, the county court formally accepted a proposition made by the Goshen Land and Improvement Company to share the cost of bridge construction (Rockbridge County Court Order Book 1889-1890:414). The details of the agreement between the two parties were recorded the same day in a contract between the Goshen Land and Improvement Company (J. Fred Effinger, Vice President, and C.L. Cooke, Secretary) and the County of Rockbridge (J.P. Moore, Special Commissioner). The Goshen Land and Improvement Company agreed to build a substantial iron bridge with stone piers not less than 18 feet wide and 120 feet in span, and of sufficient strength to carry at least 100 pounds per linear foot. In addition, the company was to construct approaches to the bridge by laying out the streets of the town so that they would intersect properly with the existing county road, in order that the road might be incorporated into the town plan. The streets of the town, the approaches, and the bridge were to be made open to the public as soon as they were completed and ready for travel, ideally by January 1, 1891. The Goshen Land and Improvement Company additionally agreed to pay for maintenance of the bridge, except in the event of flood destruction (Rockbridge County Deed Book 69:333).

According to the terms of the contract, the County of Rockbridge would pay the Goshen Land and Improvement Company the sum of \$2,900 after the bridge was complete and the construction had been approved by a commissioner appointed by the county. The county was, thereafter, to own an interest in the bridge equal to the proportion of that sum to the total cost of construction. If the Goshen Land and Improvement Company at any time failed to maintain the bridge as a proper public way, the county retained the right to take possession of the bridge and make repairs at the cost of the company (Rockbridge County Deed Book 69:333).

On August 5, 1890, the Goshen Land and Improvement Company reported to the court that it had arranged for the cancellation of the contracts previously negotiated between the county and Johnson & Cameron for the substructure, and with the Groton Bridge Company for the

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superstructure. The court then annulled the old order given on April 11, 1890, for the establishment of a public bridge across the Calfpasture River on the county road. Under the new agreement, the court appointed Humphreys as a Special Commissioner responsible for examining the bridge when completed and determining whether the construction met the requirements of the contract (Rockbridge County Court Order Book 1889-1890:420).

The Goshen Land and Improvement Company evidently renegotiated the contracts for substructure and superstructure that fall, and on October 3, 1890, the Board of Supervisors directed that a warrant for the county's contribution of \$2,900 be made payable by the County Treasurer (Rockbridge County Supervisors Order Book 2:328). The company retained the Groton Bridge Company for the construction of the superstructure, but it is not clear from the records which company was retained to build the substructure. According to the original contract, the bridge was to have been completed by January 1, 1891, but the Goshen Land and Improvement Company requested that the date be extended to May 1, 1891. On May 7, the county court further extended the completion date to June 1, 1891 (Rockbridge County Court Order Book 1891-1892:36).

The bridge was completed by June 1, and load-tested early that month. On June 4, Humphreys and the Road Commissioners of Walker's Creek Magisterial District submitted a report stating that the Goshen Land and Improvement Company had satisfactorily met their obligations as stated in the contract. Upon receipt of the report, the county court ordered that the Board of Supervisors cause the county contribution of \$2,900 to be paid to the company, and retired the case (Rockbridge County Court Order Book 1891-1892:80).

The final cost of the bridge to the Goshen Land and Improvement Company was \$16,000. In a newspaper article released on June 19, 1891, the bridge was described as 270' long "and of sufficient width to accommodate a street car line in the centre, a roadway on each side and a sidewalk six feet wide" (*Goshen Blade* 1891).

Like many other speculative ventures launched in the Shenandoah Valley in the 1890s, the Goshen Land and Improvement Company lost investors during the panic of 1893 and never regained the sales momentum enjoyed during their first two and one-half years of business (Hensley 1979:26; Rockbridge County Grantor Index:Corporations). In March of 1896, to resolve a suit brought by W.W. Nevergold and others, the Circuit Court of Rockbridge County decreed that all of the real estate of the Goshen Land and Improvement Company be sold at public auction to generate money to pay debts (Rockbridge County Deed Book 95:437).

The County Board of Supervisors appears to have assumed the maintenance responsibilities for Goshen Bridge following the financial collapse of the Goshen Land and Improvement Company. Apparently, little repair work was necessary during the first ten years, but by March of 1901, the hand railing on the bridge had deteriorated. The Board of Supervisors was of the opinion

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that the railing was a needless accessory, and ordered that the Road Board of Walker's Creek Magisterial District dispose of it (Rockbridge County Supervisors Order Book 3:216).

On June 22, 1916, the Board of Supervisors applied to the State Highway Commission for financial assistance in the maintenance of roads and bridges. State money had been made available for this purpose under an act approved on March 24, 1916 (Rockbridge County Supervisors Order Book 4:364). While money for maintenance was increasingly provided by the state, the county retained responsibility for the management of the projects until about 1920.

On December 18, 1919, the Board of Supervisors and Humphreys met on site to examine the condition of the bridge and found that the floor was badly in need of repair. Humphreys was directed to report to the Board at its next meeting on the comparative costs of steel and wooden joists, and to make a judgment as to whether the bridge was of sufficient strength to hold a concrete floor (Rockbridge County Supervisors Order Book 4:490). The following April, the Road Board of Walker's Creek Magisterial District was authorized to repair the floor with wood. The bill for the work was to be itemized and presented to the Board for auditing, and the old timbers from the bridge were to be sold and the proceeds credited to the county fund. When the work was completed, the repairs were to be examined by Humphreys (Rockbridge County Supervisors Order Book 5:4). On July 18, the bill submitted by J.S. Syles for lumber used in repairing the bridge was approved by Humphreys, and the Board issued a warrant to pay 70 percent of the cost (Rockbridge County Supervisors Order Book 5:10).

The last maintenance record for Goshen Bridge entered in the County Board of Supervisors records was dated April 19, 1920, when A.D. Bell was paid \$44.25 for materials used in bridge repairs (Rockbridge County Supervisors Order Book 5:42). Soon after this date, the state appears to have taken over bridge maintenance responsibilities.

Goshen Bridge, a remnant of the late nineteenth century investment boom that extended throughout the Shenandoah Valley, was listed in the Virginia Landmarks Register on November 15, 1977, and in the National Register of Historic Places on April 15, 1978 (Britton 1977; VDHR file 81-166).

David C. Humphreys, Engineer of Construction

At the time the Goshen Bridge was built, in 1890-91, David Carlisle Humphreys, the engineer in charge of construction, held the position of Professor of Civil Engineering at Washington and Lee University, in Lexington, Virginia. Humphreys graduated from Washington and Lee University in 1878 with a degree in civil engineering and taught for one year at the McDonogh School in Maryland. In 1879, he was appointed to the United States Corps of Engineers as an assistant engineer on the Missouri River improvement project. In 1885, he joined Washington

and Lee University as a professor of applied mathematics; he became professor of Civil Engineering in 1889 and Dean of the School of Applied Science in 1904 (Washington and Lee University 1921a:132-133).

During his tenure at Washington and Lee, Humphreys' engineering skills were employed by the university and by the town, county, state, and federal governments. From 1895 to 1906 he served as hydrographer to the U.S. Geological Survey, and in that capacity made a special study of the water flow in the James River. He also was a member of the Governor's Board of Mechanical Survey of Virginia, secretary of the Building Commission of the University, superintendent of the University's heating and power plant, a leader in the state Good Roads movement, a founding member of the Society for the Promotion of Engineering Education, a member of the American Society of Civil Engineers, and a member of the American Association for the Advancement of Science (Washington and Lee University 1921a:133, 1921b:5).

Groton Bridge Company, Groton, New York

The Groton Bridge Company began in 1849 as a blacksmith shop and foundry operated by Charles and Lyman Perrigo. The firm began building bridges in 1877 and incorporated as the Groton Iron Bridge Company at about that time. The name was changed in 1887 to the Groton Bridge and Manufacturing Company as their line of products expanded into plows, roof trusses, agricultural machinery, and other steel and iron products (Clark 1971:n.p.). The factory was built next to the Lehigh Valley Railroad tracks and the company's bridges were shipped by that line. As evidenced by an engraving of the bridge works in the company annual catalog, the factory occupied seven large brick buildings covering several city blocks (Groton Bridge Company n.d.:1).

In 1893, the company was publishing a monthly newspaper called "The Bridge Builder." At that time the principals of the company were Wm. H. Fitch, President; Frank Conger, Vice President; B.R. Williams, Secretary; C.W. Conger, Treasurer; and E.A. Landon, Engineer (Groton Bridge Company 1893:n.p.).

In 1901, the Groton Bridge Company was purchased by the newly formed American Bridge Company. The American Bridge Company was formed in 1900-1901 by J.P. Morgan as a consolidation of twenty-eight bridge companies, representing eighty percent of the structural steel fabricating capacity of the United States. At that time, the Groton plant had a manufacturing capacity of 7,200 tons of steel per year, making it one of the smaller of the twenty-eight companies purchased by American Bridge (United States Steel Corporation 1975:14, 16, 18).

Business slowed during World War I and the company began renting out some of its buildings to other manufacturing concerns. In the 1920s, the American Bridge Company moved the machinery out and permanently closed the Groton facility. The town of Groton purchased the

buildings in 1931. A majority of the buildings burned in 1961 and those remaining were demolished in 1971 to make way for an automotive dealership (Clark 1971:n.p.).

Groton Bridge manufactured a product called the "Patent Iron Piling" and claimed to have built over 1,000 bridges supported by pilings of this type, as well as a large number built on wrought iron cylinder piers filled with concrete. Outstanding works of the Groton Bridge Company, according to their catalog, include the Pennsylvania Avenue Bridge over the Potomac in Washington D.C.; the Iron Piling Wharf at Fort Monroe, Virginia, the "largest in the world" at the time; and the Jacksonville Florida Viaduct (Groton Bridge Company n.d.:41).

According to *A Survey and Photographic Inventory of Metal Truss Bridges in Virginia, 1865-1932*, a study conducted by the VDOT Research Council in 1973, the Groton Bridge Company built a total of three metal truss bridges in Virginia: two in the Staunton VDOT Construction District and one in the Bristol District (Deibler 1973).

Thomas Pratt and the Pratt Truss

Thomas Pratt was born in Boston in 1812, entered Rensselaer Polytechnic Institute at age 14, became an engineer with the United States Army Engineers at 18, and began a professional engineering career with the Boston and Maine Railroad at age 21. Pratt worked his entire life in the employ of various New England railroad companies (American Society of Civil Engineers 1876:332-333; Condit 1960:108).

Pratt is famous for a bridge truss that he designed in 1842 that consisted of two parallel chords connected by vertical wood posts in compression and double wrought iron diagonals in tension. Pratt's design was similar in appearance to an earlier truss patented by William Howe, but structurally opposite in that Howe's design put the verticals in tension and the diagonals in compression. The Pratt truss is considered to be the first scientifically designed truss, incorporating what are now considered basic structural engineering principles (Condit 1960:109). Pratt used shorter compression members, allowing members of smaller cross section to be used without sacrificing overall strength. This innovation provided a lighter truss requiring less material, yet offered greater span and load-bearing capability than the other truss designs of the time.

In 1844, Pratt was granted a patent for two truss designs, one with parallel chords and one with a polygonal top chord. The polygonal version reflected Pratt's understanding of the application of mathematical principles in calculating the forces involved and the precise strength of material required to counter those forces. Pratt's patent was renewed in 1858. The use of the Pratt truss for the deck of John Roebling's Niagara River Suspension Bridge in 1855 drew worldwide attention to the design and undoubtedly contributed to its increased use. By 1889, the truss in its iron form ranked first in usage for railroad bridges. Thousands of bridges, both highway and

railroad, have been built following the Pratt design or some variation (American Society of Civil Engineers 1876:334-335; Condit 1960:111, 112, 302; Cooper 1889:11; Johnson 1929:179).

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GOSHEN BRIDGE
(Bridge No. 6145)
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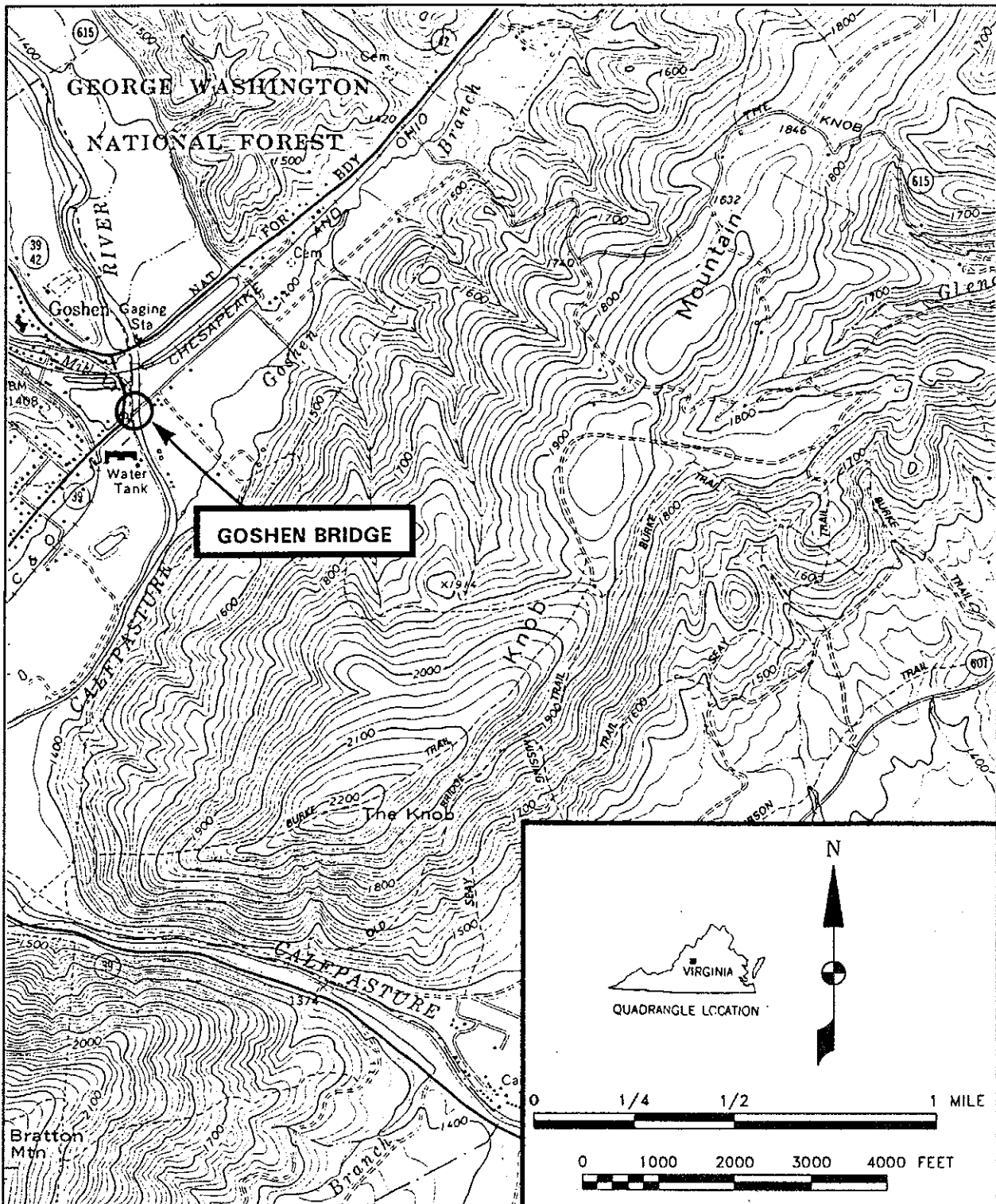


FIGURE 1: Location Map

SOURCE: USGS 7.5 Minute Quadrangle, Goshen, VA, 1967
 (Photorevised 1983)

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W.P. . . . 4/62

SOURCE: Virginia Department of Transportation 1977

FIGURE 2: Original Bridge Report, Bridge No. 6145, March 10, 1977

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SOURCE: Virginia Department of Transportation 1977

FIGURE 3: Original Bridge Report, Bridge No. 6145, March 10, 1977